HAZARDOUS MATERIALS

What They Are, How They Behave & How to Recognize Them in a Disaster

Alan Jones,
KD7KUS

Hazardous materials

- Flammable – materials which burn easily
- Reactive – materials that release energy upon exposure to air or water
- Toxic – materials which are poisonous
- Corrosive – materials which cause chemical burns, including acids, bases, oxidizers and reducers
- Carcinogenic – materials which cause cancer
- Reproductive effects – materials which cause generational defects or injury
- Radioactive – materials which emit ionizing radiation

Exposure Vectors

Pathways that a chemical takes to get into or onto your body

- Ingestion
- Inhalation
- Direct Contact
- Injection

This can’t be good ….

Risk of Injury

- (Exposure) x (Hazard Severity) = Risk of Injury
  where Exposure = (Time) x (Distance)
- While there is usually nothing we can do to minimize the hazard severity, to prevent injury:
  - Stay far away, and
  - Minimize your time near the hazard

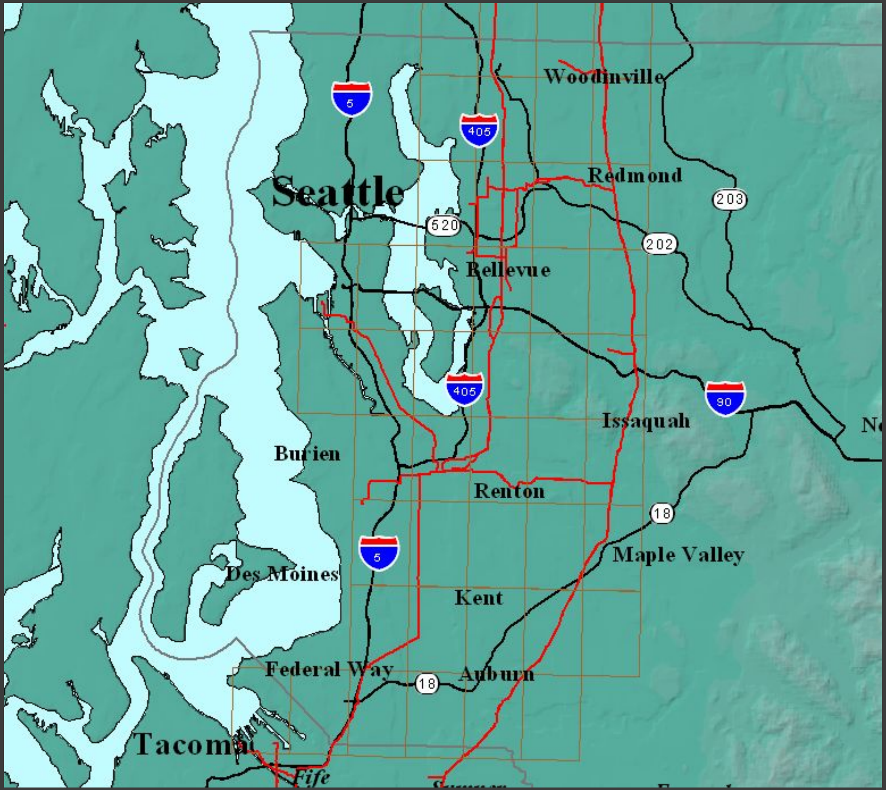
HazMats Are Useful

- Gasoline – makes our vehicles run
- Chlorine – makes plastics and disinfectants
- Acids – electrolytes in batteries and to clean stains
- Alkalis – to clean our drains
- Pesticides – kills pests and vermin and preserve our crops
- Carcinogens – preserve tissue and cement plastics

HazMats Can Be Dangerous…

- When used inappropriately:
  - Using gasoline as a cleaning solvent
  - Using bleach and ammonia to clean a refrigerator
- When they escape their primary containers:
  - A container ruptures and leaks out onto the floor
  - An oil tank car derails and spills its contents
  - A cap leaks vapors

Buried Pipelines in King County



Red lines are hazardous liquid and gas pipelines

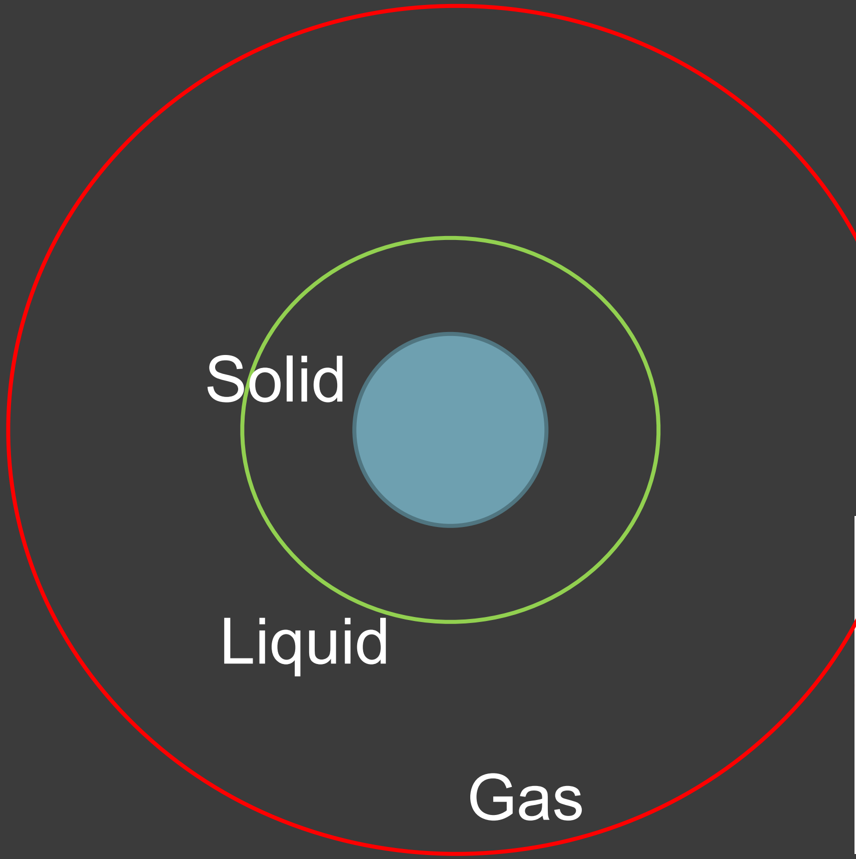
HazMat Chemistry

What you need to know to be safe around hazardous materials ….

How Quickly Will it Get to Me?

- Gas – Fastest. These are molecules and travel easily on the slightest breeze. They also diffuse rapidly in the air. Gases can ignite - they have no flash point.
- Vapors – Fast. These are aerosol droplets and also travel easily on the slightest breeze. They diffuse slowly in the air. Vapors can ignite.
- Liquid – Quick. These must flow downhill on the ground. Stay uphill of liquids!
- Solid – Slow. ‘Nuf said.

Firefighter Hot Zones



Solid

Liquid

Gas

- Solids – 75 feet
- Liquids – 150 feet
- Gases – 300 feet

Gas Density

- Only a few gases are lighter than air and rise
- The mnemonic is **HA HA MICE**
  - **H**elium
  - **A**cetylene
  - **H**ydrogen
  - **A**mmonia*
  - **M**ethane
  - **I**lluminating gases (neon)
  - **C**arbon monoxide
  - **E**thane and ethylene

* Dry (NH3). Ammonium hydroxide, NH4OH, goes down. The molecular weight of dry air is 28.97 g/mol

Vapor Density

- All liquids have vapor densities heavier than air (*have you ever found gasoline pooling on the ceiling?*)
- Many hazmats are colorless and odorless

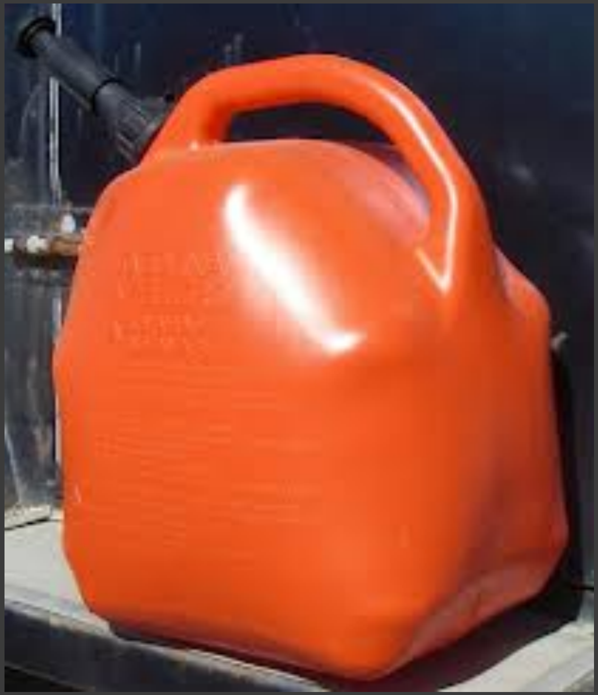
Particle Concentration in Air

If you can’t see your fingers wiggling at arm’s length the concentration is in grams/cubic meter and you need to exit immediately!

Vapor Pressure

- VP is a measure of how quickly a liquid will evaporate
- The higher a chemical's vapor pressure, the more vapor will be produced.
- Tanks with higher vapor pressure will have rounded ends:

Vapor Pressure Can Distort Containers



BLEVE: **B**oiling **L**iquid
Expanding **V**apor **E**xplosion

Boiling Point

- At the boiling point a chemical’s vapor pressure equals atmospheric pressure
- I.e., the lower the boiling point the easier the chemical can become a gas and the greater the vapor pressure
- Gases, with extremely low boiling points, must be pressurized and refrigerated to become liquids. These materials are cryogens.

Expansion Rate

- All liquid and liquified gases give off vapors. The volume of vapor is usually greater than the liquid. The difference is given as a ratio of liquid to vapor volume.
- Gasoline: b.p. = 105°F E.R. = 1:37
- Liquid Petroleum Gas: b.p. = -41°F E.R. = 1:270
- Liquid Oxygen: b.p. = -297°F E.R. = 1:700/800
- Water: b.p. = 212°F E.R. = 1:1,700

Flash Point

The temperature at which a chemical’s vapors will ignite if an ignition source is present

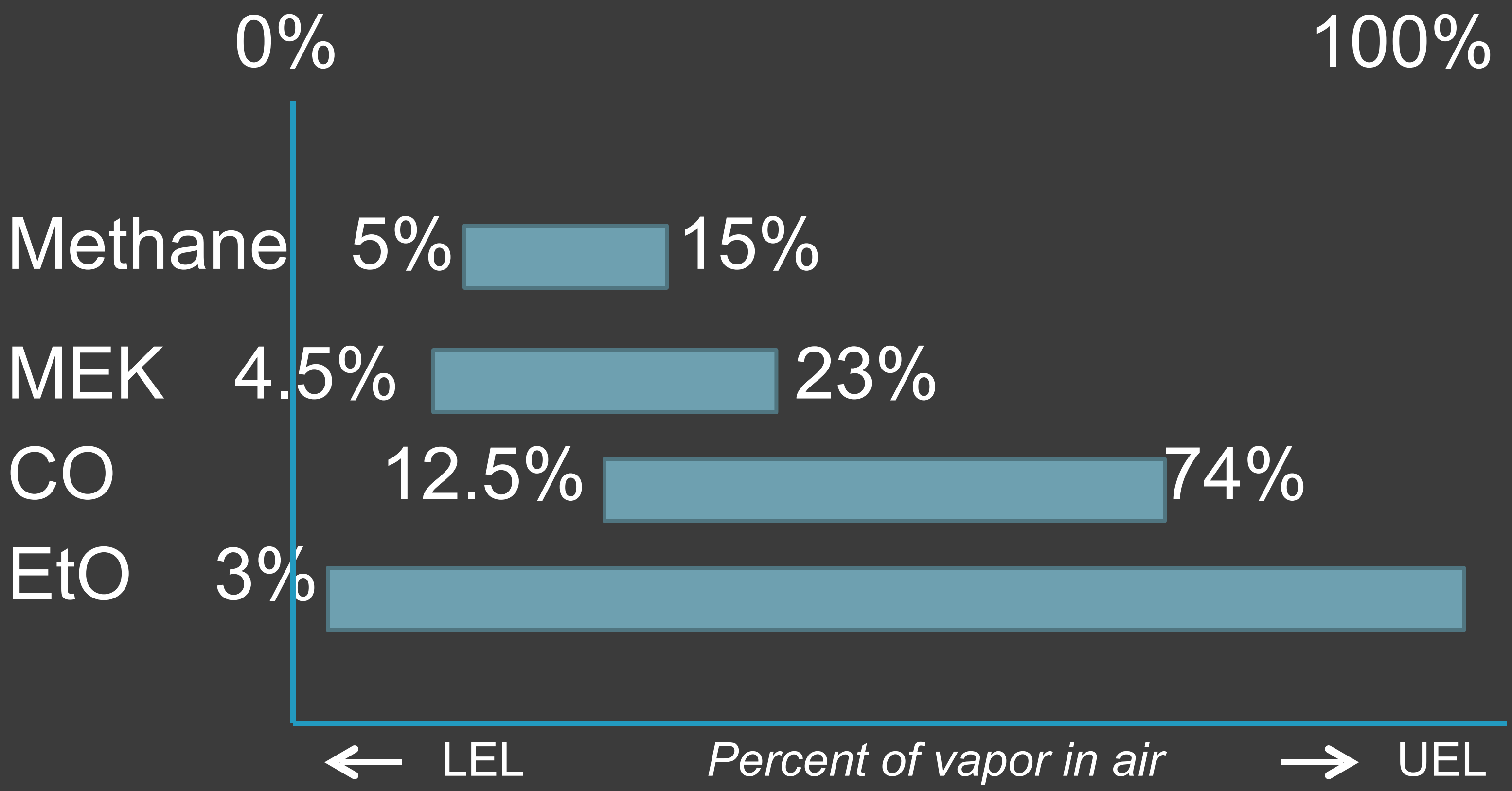
	Flash Point
Gasoline	-45°F
Methyl Ethyl Ketone	21°F
Fuel Oil	105°F

Flammable Range

Sometimes the temperature will be high enough for a chemical to emit vapors to form, but it won’t burn. The combination of air and fuel isn’t right. The concentration of vapor in air must be greater than the LEL and less than the UEL.

- ☐ The **Lower Explosive Limit** (LEL) is the minimum concentration of chemical in air that will ignite.
- ☐ The **Upper Explosive Limit** (UEL) is the maximum concentration of chemical in air that will ignite.

LELs and UELs



Auto-Ignition Temperature

The third characteristic of flammable hazmats is the auto-ignition temperature: the temperature to which the chemical must be heated to ignite even without an ignition source.

Chemical	Ignition Temperature
Carbon Disulfide	212°F
White Phosphorous	86°F
Gasoline	982°F

Water- or Solvent-Based?

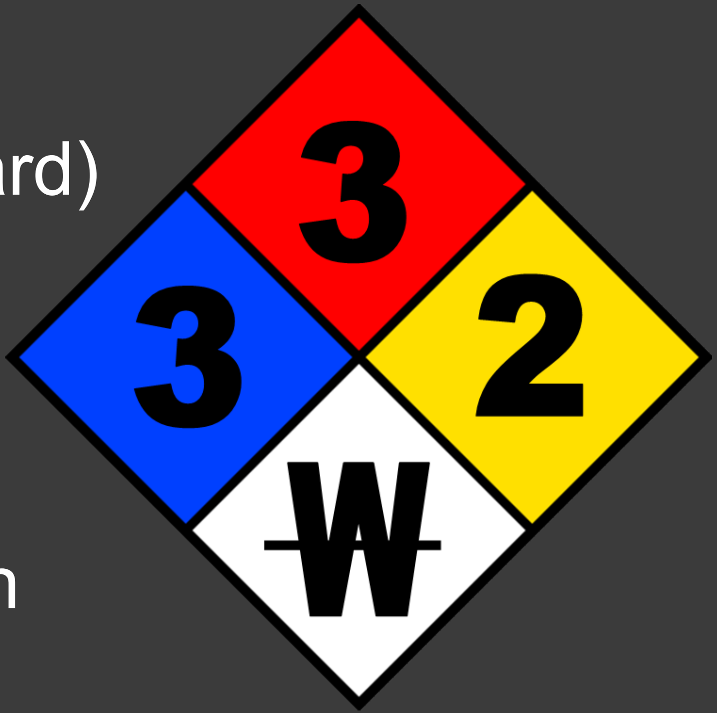
Drop in an Alka-Seltzer. If it’s water-based, it will fizz!

HazMat Label Systems

- National Fire Protection Association
- Hazardous Material Identification System
- U.S. DOT placards
- United Nations Hazard Classes
- Globally Harmonized System for the Classification and Labeling of Chemicals

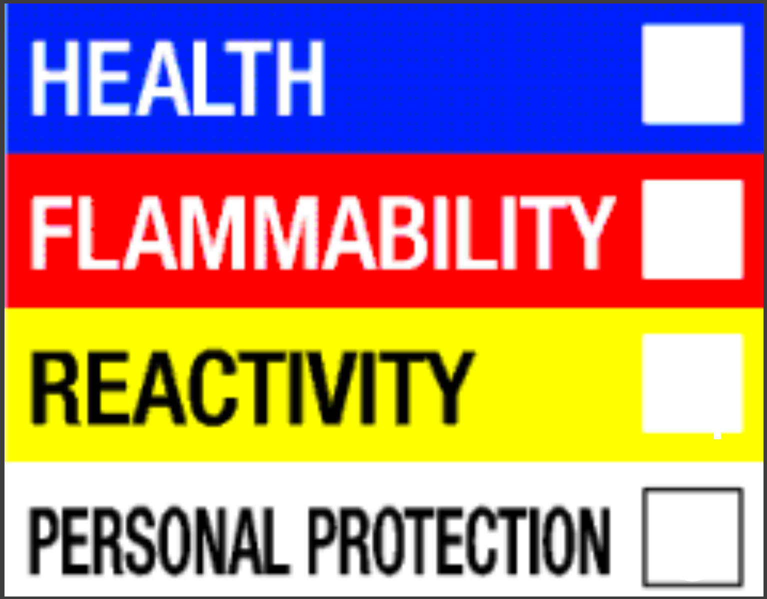
NFPA Diamond Label

- The numbers refer to the severity of the hazard
- The ranking is from 0 (no hazard) to 4 (greatest hazard)
- Red is Flammable
- Blue is Health
- Yellow is Reactivity
- White is special information



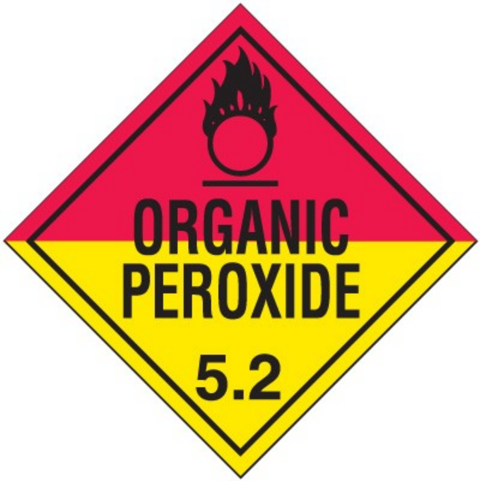
HMIS Stacked Rectangles

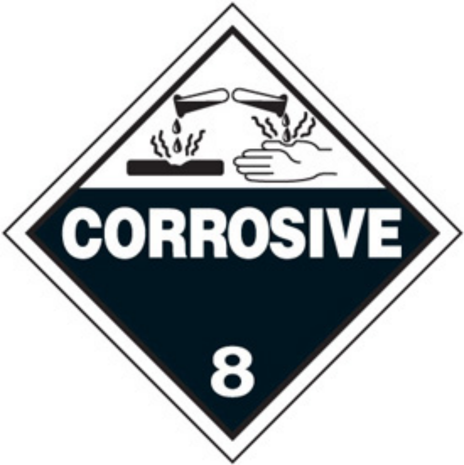
- Used on consumer-size containers
- Same ranking and hazard color system as NFPA label
- White rectangle gives PPE to use when handling

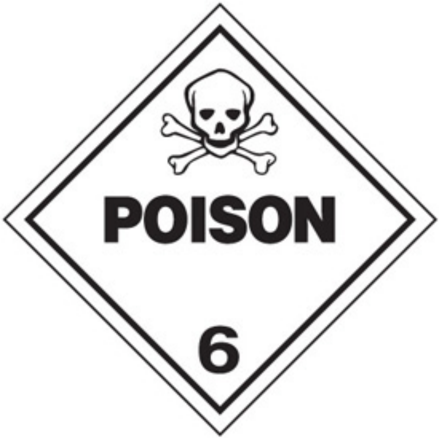


DOT Placards

- Affixed to mobile containers; e.g., rail cars, truck trailers, intermodal containers
- Many designs, but all are diamonds
- Volumes are very large
- Use binoculars!



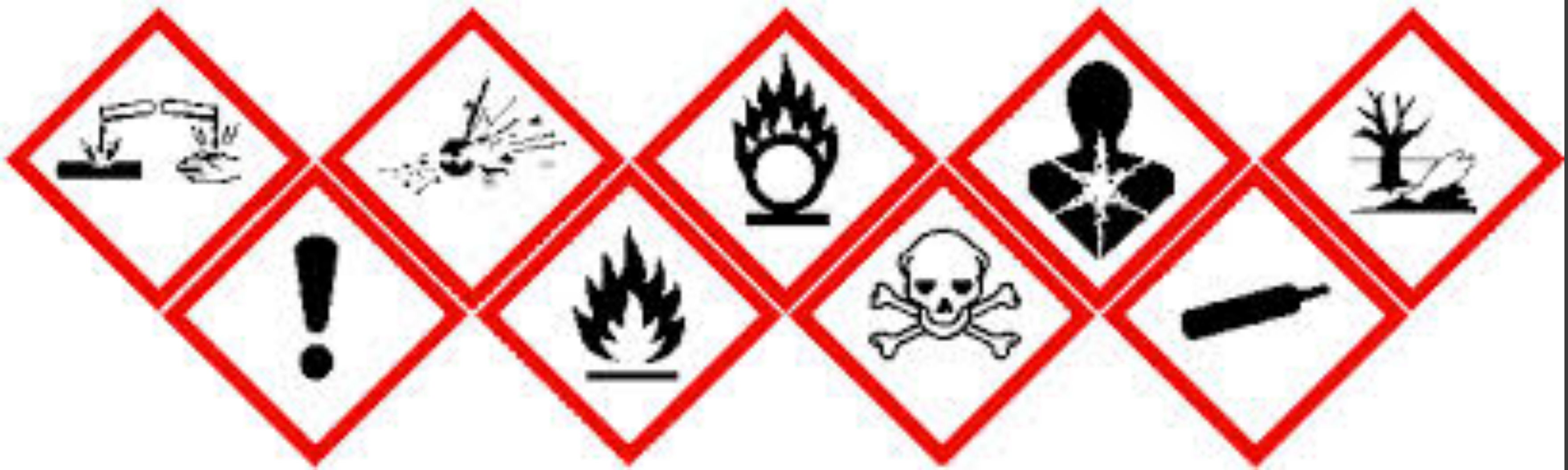




United Nations Hazard Classes

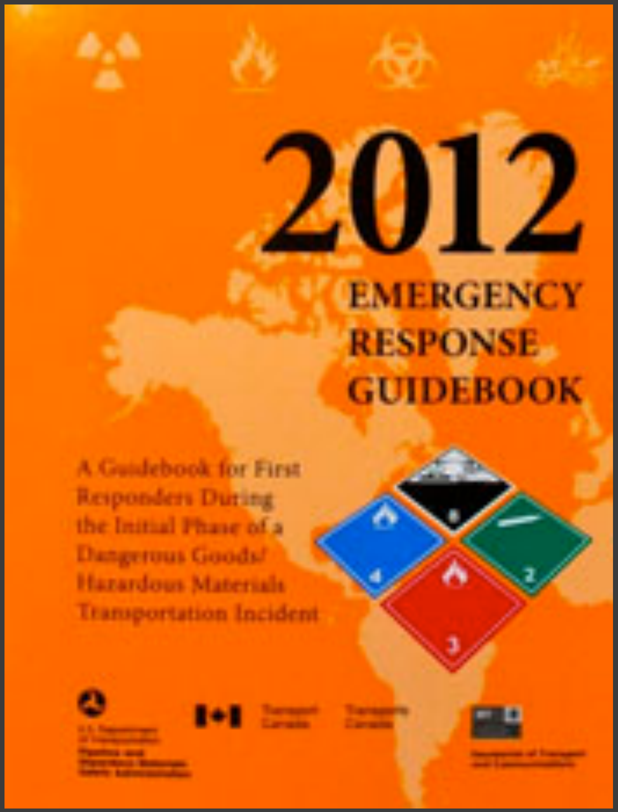
1. Flammable
2. Compressed gas
3. Flammable liquid
4. Flammable solid
5. Oxidizers
6. Toxic & Infectious
7. Radioactive
8. Corrosive
9. Miscellaneous hazard materials

Globally Harmonized System (GHS) Hazard Label Pictograms



Emergency Response Guidebook

- Carried by police, sheriffs, fire engines, EMTs, truck drivers, rail engineers
- Referencing U.S. Department of Transportation placards, it directs first responders to information on hazards, precautions, treatment of injuries, evacuations and extinguishing fires



Hazard Placards

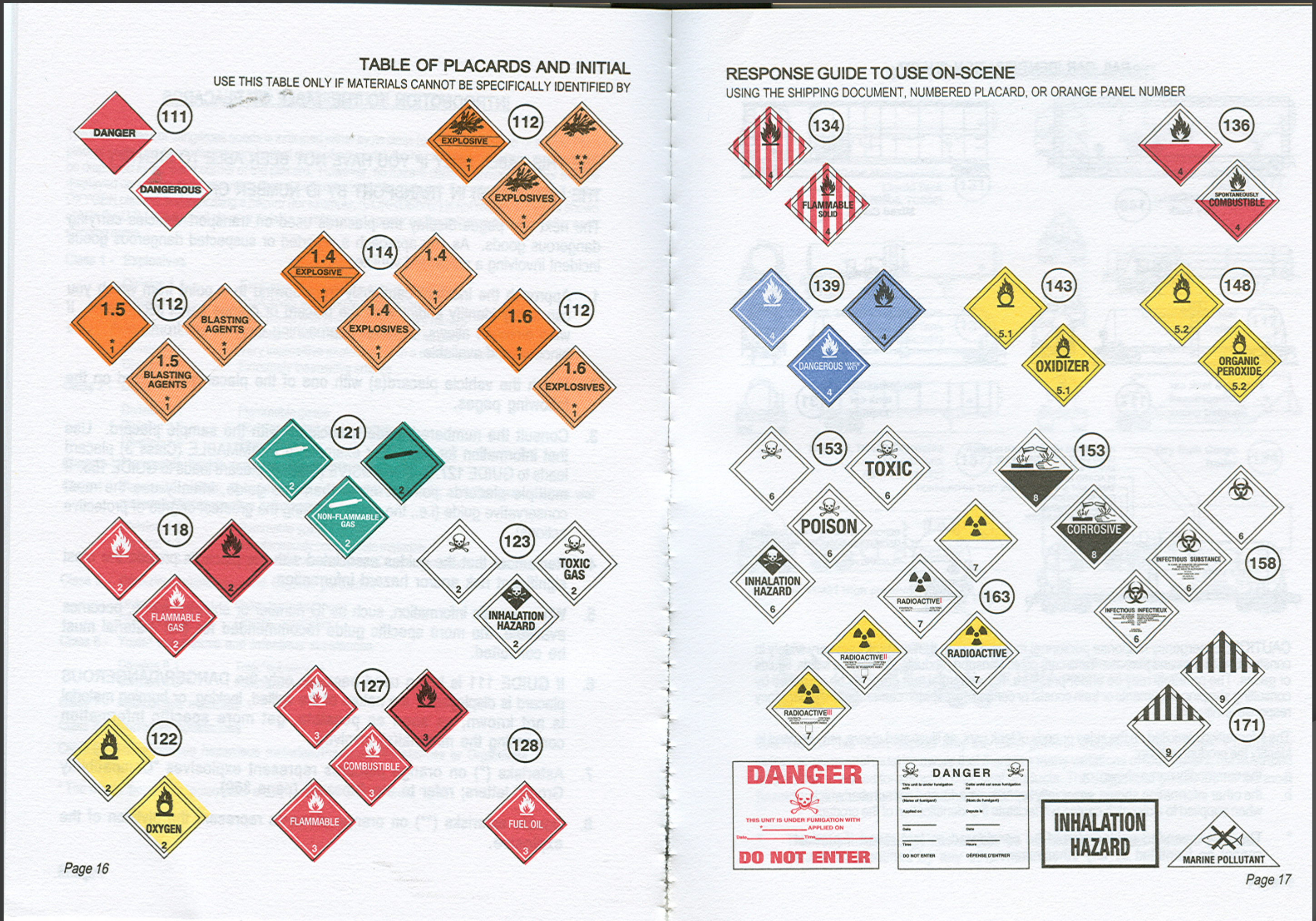


TABLE OF PLACARDS AND INITIAL

USE THIS TABLE ONLY IF MATERIALS CANNOT BE SPECIFICALLY IDENTIFIED BY

RESPONSE GUIDE TO USE ON-SCENE

USING THE SHIPPING DOCUMENT, NUMBERED PLACARD, OR ORANGE PANEL NUMBER

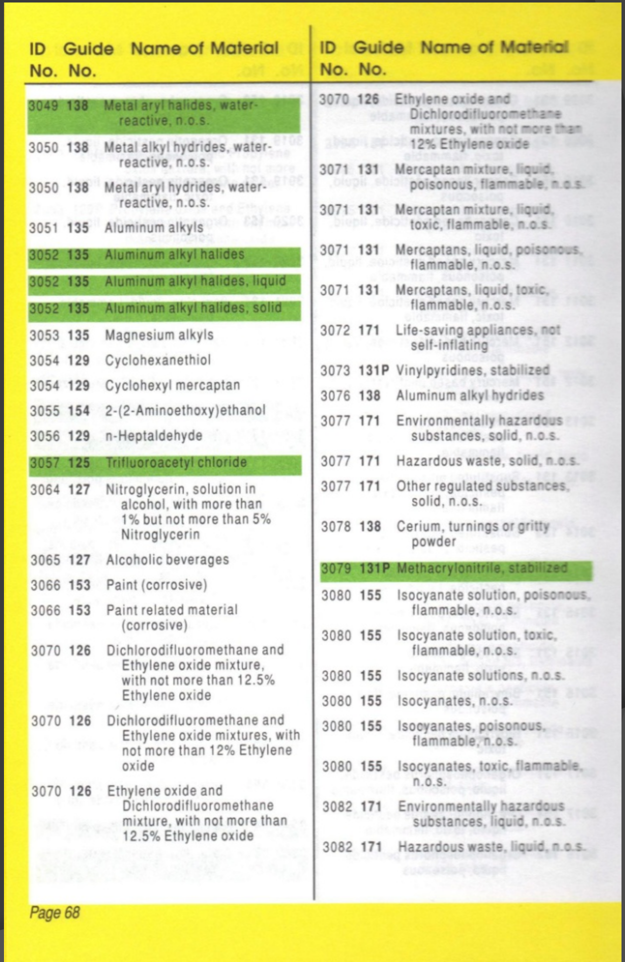
DANGER
111
DANGEROUS
EXPLOSIVE
112
EXPLOSIVES
1.4
EXPLOSIVE
114
1.4
1.5
112
BLASTING AGENTS
1.4 EXPLOSIVES
1.6
112
1.5 BLASTING AGENTS
1.6 EXPLOSIVES
121
NON-FLAMMABLE GAS
118
FLAMMABLE GAS
123
TOXIC GAS
INHALATION HAZARD
127
COMBUSTIBLE
128
FLAMMABLE
FUEL OIL
122
OXYGEN
134
FLAMMABLE SOLID
136
SPONTANEOUSLY COMBUSTIBLE
139
DANGEROUS WHEN WET
143
OXIDIZER
148
ORGANIC PEROXIDE
153
TOXIC
POISON
INHALATION HAZARD
153
CORROSIVE
158
INFECTIOUS SUBSTANCE
INFECTIOUS INFECTIEUX
RADIOACTIVE I
163
RADIOACTIVE II
RADIOACTIVE
RADIOACTIVE III
171
DANGER
THIS UNIT IS UNDER FUMIGATION WITH
APPLIED ON
DO NOT ENTER
DANGER
INHALATION HAZARD
MARINE POLLUTANT

White Section: Placards

- ERG white pages show hazard placards
- If you can only see a placard on a container spill, match it with these pages
- Placards are found on boxes, truck trailers, and railcars
- Notice the 3-digit number in a black circle by each placard: the *Guide Number.*
- Look up Guide Numbers in the Orange section, which are mini-SDSs

Chemicals by ID Number

- Container labels will often have a 4-digit chemical ID number
- ID numbers are unique for individual chemicals
- Look up chemical ID numbers in the ERG Yellow section



ID No.	Guide No.	Name of Material
3049	**138**	Metal aryl halides, water-reactive, n.o.s.
3050	**138**	Metal alkyl hydrides, water-reactive, n.o.s.
3050	**138**	Metal aryl hydrides, water-reactive, n.o.s.
3051	**135**	Aluminum alkyls
3052	**135**	Aluminum alkyl halides
3052	**135**	Aluminum alkyl halides, liquid
3052	**135**	Aluminum alkyl halides, solid
3053	**135**	Magnesium alkyls
3054	**129**	Cyclohexanethiol
3054	**129**	Cyclohexyl mercaptan
3055	**154**	2-(2-Aminoethoxy)ethanol
3056	**129**	n-Heptaldehyde
3057	**125**	Trifluoroacetyl chloride
3064	**127**	Nitroglycerin, solution in alcohol, with more than 1% but not more than 5% Nitroglycerin
3065	**127**	Alcoholic beverages
3066	**153**	Paint (corrosive)
3066	**153**	Paint related material (corrosive)
3070	**126**	Dichlorodifluoromethane and Ethylene oxide mixture, with not more than 12.5% Ethylene oxide
3070	**126**	Dichlorodifluoromethane and Ethylene oxide mixtures, with not more than 12% Ethylene oxide
3070	**126**	Ethylene oxide and Dichlorodifluoromethane mixture, with not more than 12.5% Ethylene oxide
3070	**126**	Ethylene oxide and Dichlorodifluoromethane mixtures, with not more than 12% Ethylene oxide
3071	**131**	Mercaptan mixture, liquid, poisonous, flammable, n.o.s.
3071	**131**	Mercaptan mixture, liquid, toxic, flammable, n.o.s.
3071	**131**	Mercaptans, liquid, poisonous, flammable, n.o.s.
3071	**131**	Mercaptans, liquid, toxic, flammable, n.o.s.
3072	**171**	Life-saving appliances, not self-inflating
3073	**131P**	Vinylpyridines, stabilized
3076	**138**	Aluminum alkyl hydrides
3077	**171**	Environmentally hazardous substances, solid, n.o.s.
3077	**171**	Hazardous waste, solid, n.o.s.
3077	**171**	Other regulated substances, solid, n.o.s.
3078	**138**	Cerium, turnings or gritty powder
3079	**131P**	Methacrylonitrile, stabilized
3080	**155**	Isocyanate solution, poisonous, flammable, n.o.s.
3080	**155**	Isocyanate solution, toxic, flammable, n.o.s.
3080	**155**	Isocyanate solutions, n.o.s.
3080	**155**	Isocyanates, n.o.s.
3080	**155**	Isocyanates, poisonous, flammable, n.o.s.
3080	**155**	Isocyanates, toxic, flammable, n.o.s.
3082	**171**	Environmentally hazardous substances, liquid, n.o.s.
3082	**171**	Hazardous waste, liquid, n.o.s.

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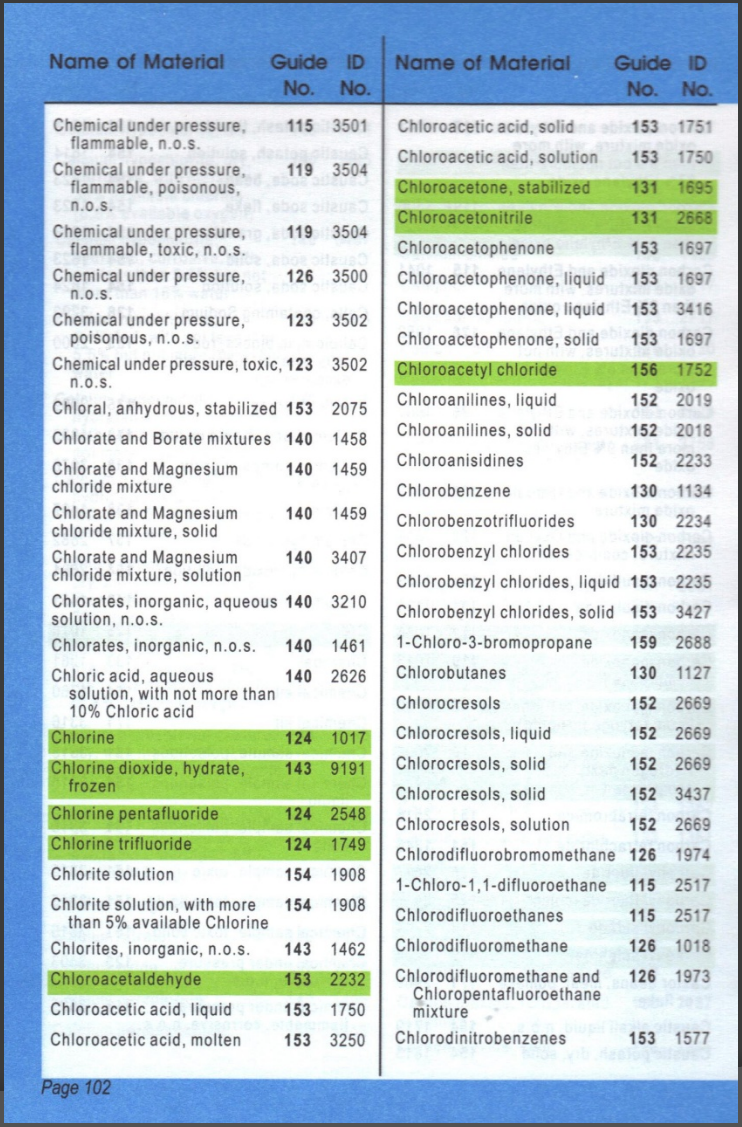
Chemicals by Name



Name of Material	Guide No.	ID No.
Chemical under pressure, flammable, n.o.s.	**115**	3501
Chemical under pressure, flammable, poisonous, n.o.s.	**119**	3504
Chemical under pressure, flammable, toxic, n.o.s.	**119**	3504
Chemical under pressure, n.o.s.	**126**	3500
Chemical under pressure, poisonous, n.o.s.	**123**	3502
Chemical under pressure, toxic, n.o.s.	**123**	3502
Chloral, anhydrous, stabilized	**153**	2075
Chlorate and Borate mixtures	**140**	1458
Chlorate and Magnesium chloride mixture	**140**	1459
Chlorate and Magnesium chloride mixture, solid	**140**	1459
Chlorate and Magnesium chloride mixture, solution	**140**	3407
Chlorates, inorganic, aqueous solution, n.o.s.	**140**	3210
Chlorates, inorganic, n.o.s.	**140**	1461
Chloric acid, aqueous solution, with not more than 10% Chloric acid	**140**	2626
Chlorine	**124**	1017
Chlorine dioxide, hydrate, frozen	**143**	9191
Chlorine pentafluoride	**124**	2548
Chlorine trifluoride	**124**	1749
Chlorite solution	**154**	1908
Chlorite solution, with more than 5% available Chlorine	**154**	1908
Chlorites, inorganic, n.o.s.	**143**	1462
Chloroacetaldehyde	**153**	2232
Chloroacetic acid, liquid	**153**	1750
Chloroacetic acid, molten	**153**	3250
Chloroacetic acid, solid	**153**	1751
Chloroacetic acid, solution	**153**	1750
Chloroacetone, stabilized	**131**	1695
Chloroacetonitrile	**131**	2668
Chloroacetophenone	**153**	1697
Chloroacetophenone, liquid	**153**	1697
Chloroacetophenone, liquid	**153**	3416
Chloroacetophenone, solid	**153**	1697
Chloroacetyl chloride	**156**	1752
Chloroanilines, liquid	**152**	2019
Chloroanilines, solid	**152**	2018
Chloroanisidines	**152**	2233
Chlorobenzene	**130**	1134
Chlorobenzotrifluorides	**130**	2234
Chlorobenzyl chlorides	**153**	2235
Chlorobenzyl chlorides, liquid	**153**	2235
Chlorobenzyl chlorides, solid	**153**	3427
1-Chloro-3-bromopropane	**159**	2688
Chlorobutanes	**130**	1127
Chlorocresols	**152**	2669
Chlorocresols, liquid	**152**	2669
Chlorocresols, solid	**152**	2669
Chlorocresols, solid	**152**	3437
Chlorocresols, solution	**152**	2669
Chlorodifluorobromomethane	**126**	1974
1-Chloro-1,1-difluoroethane	**115**	2517
Chlorodifluoroethanes	**115**	2517
Chlorodifluoromethane	**126**	1018
Chlorodifluoromethane and Chloropentafluoroethane mixture	**126**	1973
Chlorodinitrobenzenes	**153**	1577

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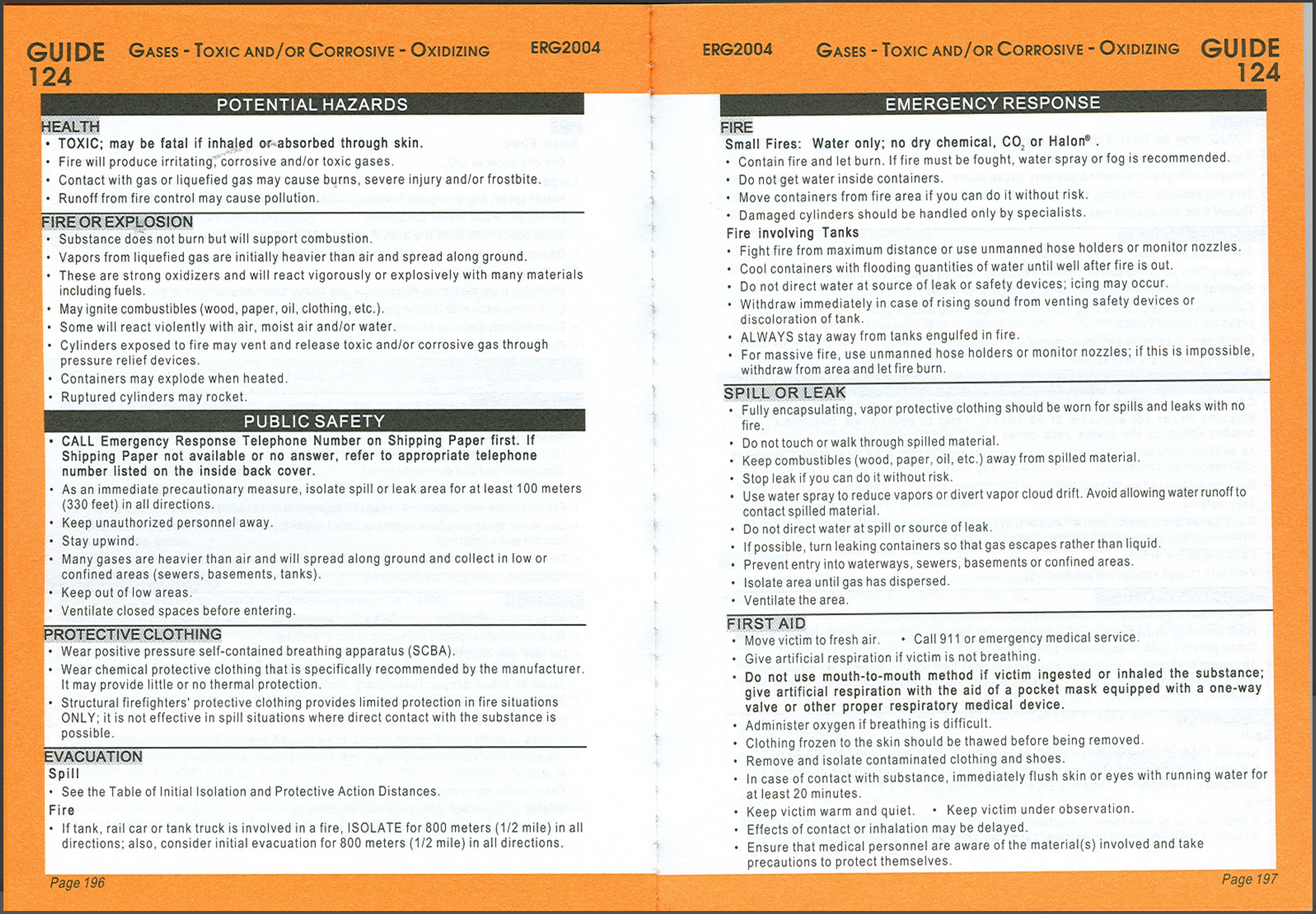
- Container labels will usually list the chemical's name
- Look up a chemical's name in the ERG Blue section

Orange Section

- When you have the 3-digit Guide Number (from consulting the container label and the ERG white, yellow or blue section), then
- Look up the Guide Number in the orange section.
- The orange section reveals potential hazards, personal protective equipment, and the appropriate emergency response

Orange: Potential Hazards & Emergency Response



GUIDE 124 GASES - TOXIC AND/OR CORROSIVE - OXIDIZING ERG2004

POTENTIAL HAZARDS

HEALTH

- **TOXIC; may be fatal if inhaled or absorbed through skin.**
- Fire will produce irritating, corrosive and/or toxic gases.
- Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite.
- Runoff from fire control may cause pollution.

FIRE OR EXPLOSION

- Substance does not burn but will support combustion.
- Vapors from liquefied gas are initially heavier than air and spread along ground.
- These are strong oxidizers and will react vigorously or explosively with many materials including fuels.
- May ignite combustibles (wood, paper, oil, clothing, etc.).
- Some will react violently with air, moist air and/or water.
- Cylinders exposed to fire may vent and release toxic and/or corrosive gas through pressure relief devices.
- Containers may explode when heated.
- Ruptured cylinders may rocket.

PUBLIC SAFETY

- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- As an immediate precautionary measure, isolate spill or leak area for at least 100 meters (330 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Keep out of low areas.
- Ventilate closed spaces before entering.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer. It may provide little or no thermal protection.
- Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

EVACUATION

Spill

- See the Table of Initial Isolation and Protective Action Distances.

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

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ERG2004 GASES - TOXIC AND/OR CORROSIVE - OXIDIZING **GUIDE 124**

EMERGENCY RESPONSE

FIRE

Small Fires: Water only; no dry chemical, CO_2 or Halon®.

- Contain fire and let burn. If fire must be fought, water spray or fog is recommended.
- Do not get water inside containers.
- Move containers from fire area if you can do it without risk.
- Damaged cylinders should be handled only by specialists.

Fire involving Tanks

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Do not direct water at source of leak or safety devices; icing may occur.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks engulfed in fire.
- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

SPILL OR LEAK

- Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire.
- Do not touch or walk through spilled material.
- Keep combustibles (wood, paper, oil, etc.) away from spilled material.
- Stop leak if you can do it without risk.
- Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material.
- Do not direct water at spill or source of leak.
- If possible, turn leaking containers so that gas escapes rather than liquid.
- Prevent entry into waterways, sewers, basements or confined areas.
- Isolate area until gas has dispersed.
- Ventilate the area.

FIRST AID

- Move victim to fresh air. • Call 911 or emergency medical service.
- Give artificial respiration if victim is not breathing.
- **Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.**
- Administer oxygen if breathing is difficult.
- Clothing frozen to the skin should be thawed before being removed.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Keep victim warm and quiet. • Keep victim under observation.
- Effects of contact or inhalation may be delayed.
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

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The Green Section

- Has entries for highlighted chemicals from blue and yellow sections
- These chemicals evaporate to form vapor or gas
- Defines initial isolation and downwind evacuation distances

Evacuation Distances

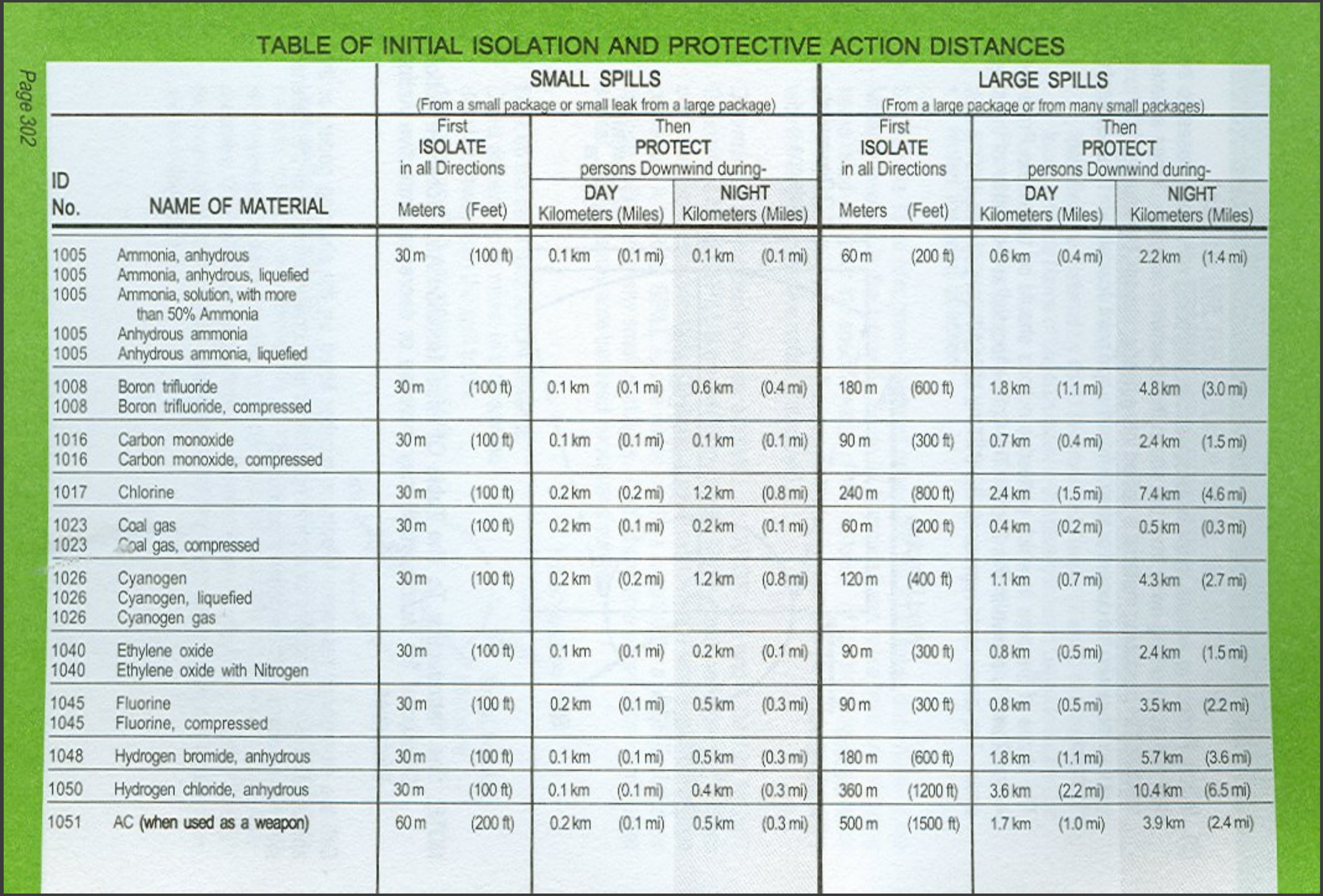

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TABLE OF INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES

		SMALL SPILLS (From a small package or small leak from a large package)						LARGE SPILLS (From a large package or from many small packages)					
		First ISOLATE in all Directions		Then PROTECT persons Downwind during-				First ISOLATE in all Directions		Then PROTECT persons Downwind during-			
				DAY		NIGHT				DAY		NIGHT	
ID No.	NAME OF MATERIAL	Meters	(Feet)	Kilometers	(Miles)	Kilometers	(Miles)	Meters	(Feet)	Kilometers	(Miles)	Kilometers	(Miles)
1005 1005 1005 1005 1005	Ammonia, anhydrous Ammonia, anhydrous, liquefied Ammonia, solution, with more than 50% Ammonia Anhydrous ammonia Anhydrous ammonia, liquefied	30 m	(100 ft)	0.1 km	(0.1 mi)	0.1 km	(0.1 mi)	60 m	(200 ft)	0.6 km	(0.4 mi)	2.2 km	(1.4 mi)
1008 1008	Boron trifluoride Boron trifluoride, compressed	30 m	(100 ft)	0.1 km	(0.1 mi)	0.6 km	(0.4 mi)	180 m	(600 ft)	1.8 km	(1.1 mi)	4.8 km	(3.0 mi)
1016 1016	Carbon monoxide Carbon monoxide, compressed	30 m	(100 ft)	0.1 km	(0.1 mi)	0.1 km	(0.1 mi)	90 m	(300 ft)	0.7 km	(0.4 mi)	2.4 km	(1.5 mi)
1017	Chlorine	30 m	(100 ft)	0.2 km	(0.2 mi)	1.2 km	(0.8 mi)	240 m	(800 ft)	2.4 km	(1.5 mi)	7.4 km	(4.6 mi)
1023 1023	Coal gas Coal gas, compressed	30 m	(100 ft)	0.2 km	(0.1 mi)	0.2 km	(0.1 mi)	60 m	(200 ft)	0.4 km	(0.2 mi)	0.5 km	(0.3 mi)
1026 1026 1026	Cyanogen Cyanogen, liquefied Cyanogen gas	30 m	(100 ft)	0.2 km	(0.2 mi)	1.2 km	(0.8 mi)	120 m	(400 ft)	1.1 km	(0.7 mi)	4.3 km	(2.7 mi)
1040 1040	Ethylene oxide Ethylene oxide with Nitrogen	30 m	(100 ft)	0.1 km	(0.1 mi)	0.2 km	(0.1 mi)	90 m	(300 ft)	0.8 km	(0.5 mi)	2.4 km	(1.5 mi)
1045 1045	Fluorine Fluorine, compressed	30 m	(100 ft)	0.2 km	(0.1 mi)	0.5 km	(0.3 mi)	90 m	(300 ft)	0.8 km	(0.5 mi)	3.5 km	(2.2 mi)
1048	Hydrogen bromide, anhydrous	30 m	(100 ft)	0.1 km	(0.1 mi)	0.5 km	(0.3 mi)	180 m	(600 ft)	1.8 km	(1.1 mi)	5.7 km	(3.6 mi)
1050	Hydrogen chloride, anhydrous	30 m	(100 ft)	0.1 km	(0.1 mi)	0.4 km	(0.3 mi)	360 m	(1200 ft)	3.6 km	(2.2 mi)	10.4 km	(6.5 mi)
1051	AC **(when used as a weapon)**	60 m	(200 ft)	0.2 km	(0.1 mi)	0.5 km	(0.3 mi)	500 m	(1500 ft)	1.7 km	(1.0 mi)	3.9 km	(2.4 mi)

Obtaining the ERG

- www.jjkeller.com – about $3.69 for small format, $7.69 for spiral-bound large format
- Free 2012 ERG app for Android from Google Play website or for iPhone from Apple iTunes website
- http://phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/Hazmat/ERG2012.pdf

Ok, it's hazardous. Now what?

- Stay uphill and upwind from the release
- For a hazmat response you need:
  - Training
  - Manpower
  - Equipment

Report to Fire Department

- Where you are: intersection or address
- What the material is or describe the placard
- Are there any injuries or victims? [DON’T GO IN!]
- Is there a vapor cloud? If so, what direction is the prevailing breeze?
- Is it flowing towards a storm drain or nearby surface water?

When is it Unsafe?

- Anytime a chemical has escaped its container
- At an unsafe level, injuries are not fatal because the concentration is low or length of exposure is short
- The longer you are exposed, the greater the harm
- Immediate monitoring of vapor or gas concentrations or recognizing visual clues is vital to safety
- When a chemical container is involved, there are only two things that will exit the container-energy or matter

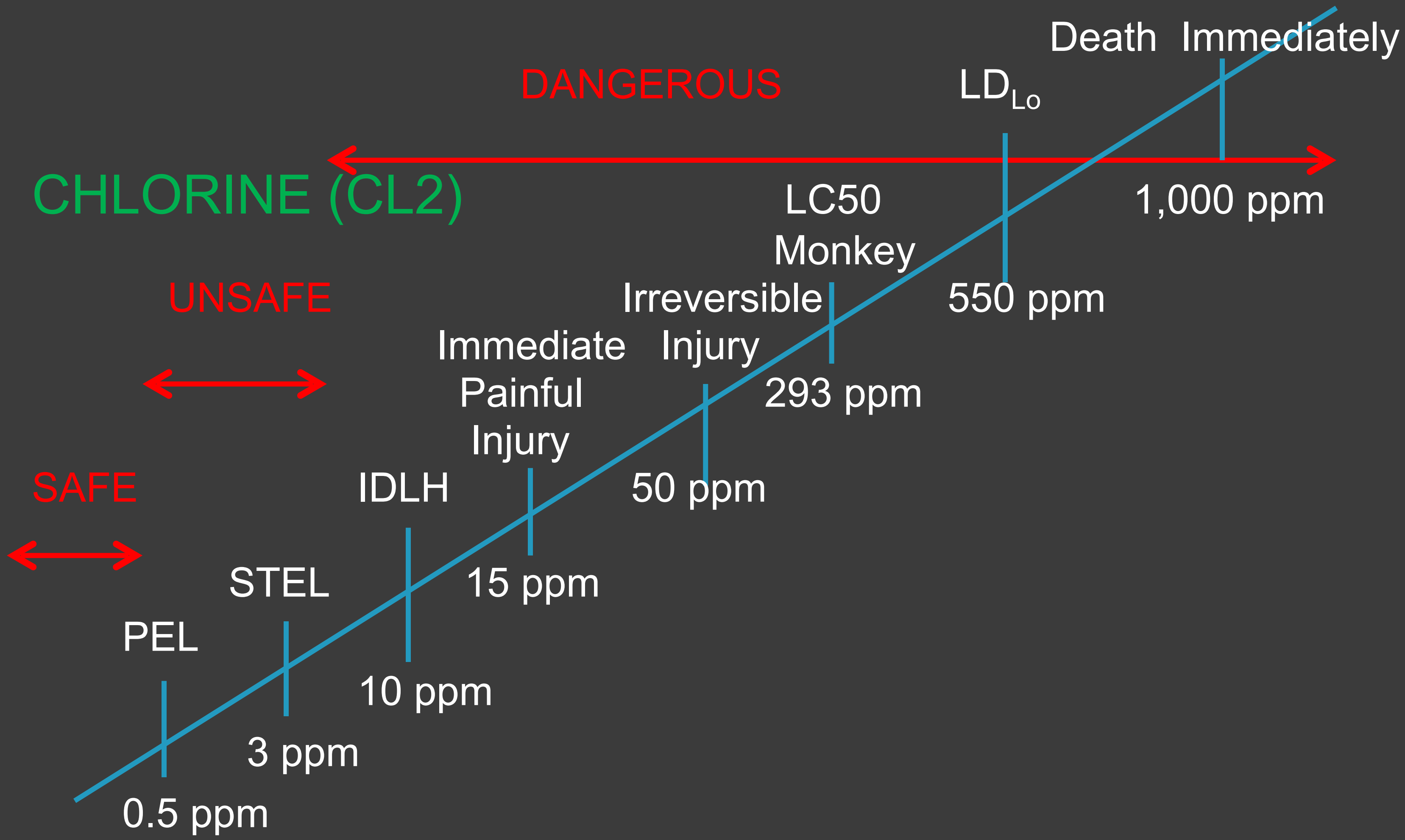
IDLH Conditions

- **I**mmediately **D**angerous to **L**ife and **H**ealth – the maximum level from which a worker could escape without irreversible health effects within 30 minutes
- IDLH is the reason some responders die and others live
- IDLH atmospheres:
  - Toxic
  - Oxygen deficient (< 19.5%)
  - Flammable
  - Oxygen enriched (> 23.5%)

Visible Indicators of IDLH

- Vapor cloud or large liquid leak
- Below-grade or behind-artificial-barrier victim
- Dead foliage or animal
- Chemical warning placards
- Heavy odors or strong sensory warnings

Poison Line



CHLORINE (CL2)

SAFE

UNSAFE

DANGEROUS

PEL

0.5 ppm

STEL

3 ppm

IDLH

10 ppm

Immediate Painful Injury

15 ppm

Irreversible Injury

50 ppm

LC50 Monkey

293 ppm

LD_{Lo}

550 ppm

Death Immediately

1,000 ppm

Toxicity=LD_{50} : Lethal Dose, 50%

That concentration of chemical that when fed to rats will kill 50% of the rats

Chemical	LD_{50} (mg/min/m^3)	LD_{50} (ppm)
Sarin	100	
Hydrogen Cyanide	2000-4000	17
Phosgene	5,000	
Botox		0.0000003

Flammable = Toxic

All flammable liquids are toxic – there are no exceptions

Don’t be a HazMat Victim!